or DC resistance. Change in DC resistance may be determined, for example, by measuring change in temperature at constant voltage. The change in one of these illustrative properties of a sensor material is a function of the partial pressure of an analyte gas within the gas mixture, which in turn determines the concentration in which the molecules of the analyte gas become adsorbed on the surface of a sensor material, thus affecting the electrical response characteristics of that material. By using an array of chemo/electro-active materials, a pattern of the respective responses exhibited by the materials upon exposure to one or more analyte gas can be used to simultaneously and directly detect the presence of, and/or measure the concentration of, at least one gas in a multi-component gas system. The invention, in turn, can be used to determine the composition of the gas system. The concept is illustrated schematically in Figure 1 and is exemplified below.

To illustrate, consider the theoretical example below where a response is obtanied, which is depicted as positive (+), or no response is obtained, which is depicted as negative (-). Material 1 responds to Gas 1 and Gas 2, but shows no response to Gas 3. Material 2 responds to Gas 1 and Gas 3, but shows no response to Gas 2, and Material 3 responds to Gas 2 and Gas 3, but shows no response to Gas 1.

	Material 1	Material 2	Material 3
Gas 1	+	+	-
Gas 2	+	-	+
Gas 3	-	+	+

Therefore, if an array consisting of Materials 1, 2 and 3 gives the following response to an unknown gas,

	Material 1	Material 2	Material 3
Unknown Gas	+	-	+

then the unknown gas would be identified as Gas 2. The response of each material would be a function of the partial pressure within the mixture of, and thus the concentration of, the analyte gas; and the reponse could be recorded as a numerical value. In such case, the numerical values of the responses can be used to give quantitative information on the concentration within the mixture of the analyte gas. In a multicomponent gas system, chemometrics, neural networks or other pattern recognition techniques could be used to calculate the concentration of one or more anylayte gases in the mixture of the system.

The chemo/electro-active material can be of any type, but especially useful are semiconducting metal oxides such as ZnO, TiO_2, WO_3, and SnO_2. These particular materials are advantageous due to their chemical and thermal stability. The semiconducting material can be a mixture of a semiconducting material with other semiconducting materials, or with any inorganic material, or combinations thereof. The semiconducting materials of interest can be deposited on a suitable solid substrate that is an insulator such as, but not limited to, alumina or silica and is stable under the conditions of the multi-component gas mixture. The array then takes the form of the sensor materials as deposited on the substrate. Other suitable sensor materials include single crystal or polycrystalline semiconductors of the bulk or thin film type, amorphous semiconducting materials, and semiconductor materials that are not composed of metal oxides.

The chemo/electro-active materials used as sensor materials in this invention may, for example, be metal oxides of the formula M^1O_x, $M^1{}_aM^2{}_bO_x$, or $M^1{}_aM^2{}_bM^3{}_cO_x$; or mixtures thereof, wherein

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M^1, M^2 and M^3 are metals that form stable oxides when fired in the presence of oxygen above 500°C;

M^1 is selected from Periodic Groups 2-15 and the lanthanide group;

M^2 and M^3 are independently selected from Periodic Groups 1-15 and the lanthanide group;

a, b, and c are each independently in the range of about 0.0005 to about 1, provided that a+b+c = 1; and

x is a number sufficient so that the oxygen present balances the charges of the other elements in the compound.

The metal oxides that contain more than one metal do not have to be a compound or solid solution, but can be a mixture of discrete metal oxides. They may exhibit composition gradients, and can be crystalline or amorphous. Suitable metal oxides are those that are

1) when at a temperature of about 400°C or above, have a resistivity of about 1 to about 10^5 ohm-cm, and preferably about 10 to about 10^4 ohm-cm,
2) show a chemo/electro response to at least one gas of interest, and
3) are stable and have mechanical integrity, that is are able to adhere to the substrate and not degrade at the operating temperature.

The metal oxides may also contain minor or trace amounts of hydration and elements present in the precursor materials.

In certain preferred embodiments, the metal oxide materials may include those in which

M^1 is selected from the group consisting of Ce, Co, Cu, Fe, Ga, Nb, Ni, Pr, Ru, Sn, Ti, Tm, W, Yb, Zn, and Zr; and/or

M^2 and M^3 are each independently selected from the group consisting of Al, Ba, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Ga, Ge, In, K, La, Mg, Mn, Mo, Na, Nb, Ni, Pb, Pr, Rb, Ru, Sb, Sc, Si, Sn, Sr, Ta, Ti, Tm, V, W, Y, Yb, Zn, and Zr, but M^2 and M^3 are not the same in $M^1_aM^2_bM^3_cO_x$.